

300C/15 kW power converter with AlGaIn/GaN-Si MOS-HFETs for electric propulsion systems, Phase II

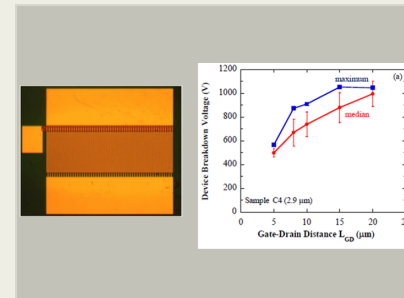
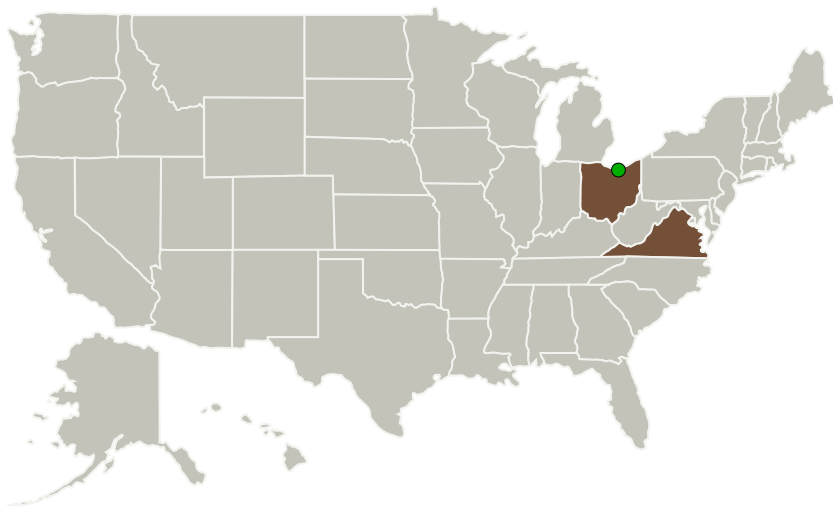
Completed Technology Project (2014 - 2016)



Project Introduction

Capitalizing on a strong expertise in III-Nitride epitaxy, GaN-Si power device designs, and wide-bandgap power electronics, researchers at GeneSiC Semiconductor propose a SBIR program focused on the development of 15 kW/300C-rated power converters using AlGaIn/GaN-Si MOS-HFETs and Schottky rectifiers. The proposed AlGaIn/GaN-Si power converters to be developed in this program will usher in a new generation of high-efficiency, low-cost, and radiation-hard power conversion units on-board future NASA spacecraft. Phase I of this proposed work focussed on the optimization of the design and fabrication of the AlGaIn/GaN-Si MOS-HFET and NSJ SBR devices. Phase II will be focused on the design and integration of Si/GaN gate-drive circuitry with the power SBRs and transistors to create high-power integrated circuits. Another major objective during Phase II will be the construction of Rad-Hard packaging for the power ICs. At the end of Phase II of this program, a fully-functional 15 kW/300C rated power converter IC equipped with AlGaIn/GaN-on-Si MOS-HFETs, Natural SuperJunction (NSJ) SBRs as free-wheeling diodes and on-chip SiC or III-Nitride gate drive circuitry will be demonstrated at a switching frequency of ≥ 1 MHz and at a temperature of ≥ 300 C. As compared to the existing state-of-the-art power electronics technology, the proposed AlGaIn/GaN-on-Si power converters will offer (A) Lower on-state losses, 300C operation and 1 MHz switching capability (B) A Lateral device architecture, which is highly desirable for construction for monolithic power integrated circuits (C) Possibility of hybrid interconnection of III-Nitride Power Devices with on-chip Rad-Hard AlGaIn/GaN Gate Drive Circuitry (D) Desirable Normally-OFF Power Switches

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
GeneSiC Semiconductor Inc.	Lead Organization	Industry Minority-Owned Business, Small Disadvantaged Business (SDB)	Dulles, Virginia
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations

Ohio	Virginia
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Project Transitions

▶ **April 2014:** Project Start

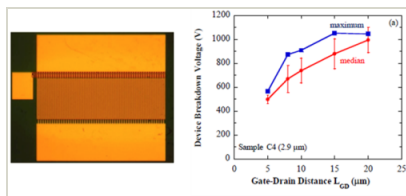
✓ **July 2016:** Closed out

Closeout Summary: 300C/15 kW power converter with AlGaIn/GaN-Si MOS-HFETs for electric propulsion systems, Phase II Project Image

Closeout Documentation:

- Final Summary Chart Image(<https://techport.nasa.gov/file/137744>)

Images

**Briefing Chart Image**

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(<https://techport.nasa.gov/image/130551>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

GeneSiC Semiconductor Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

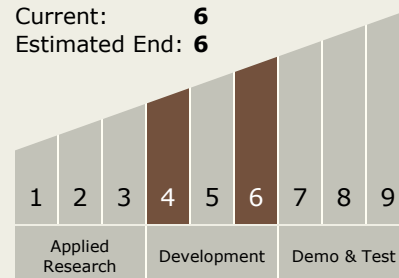
Carlos Torrez

Principal Investigator:

Siddarth Sundaresan

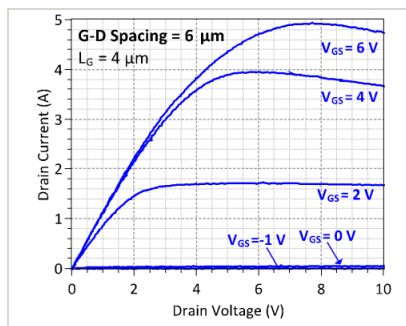
Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



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Final Summary Chart Image

300C/15 kW power converter with AlGaIn/GaN-Si MOS-HFETs for electric propulsion systems, Phase II Project Image
(<https://techport.nasa.gov/image/135722>)

Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.2 Electric Space Propulsion
 - └ TX01.2.2 Electrostatic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System